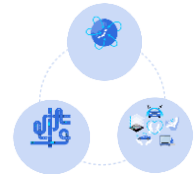


The 12th Japan ITS Promotion Forum

Automated Driving Systems



Large-Scale Field Operational Tests

Masato Minakata

SIP-adus International Cooperation Working Group/
Toyota Motor Corporation



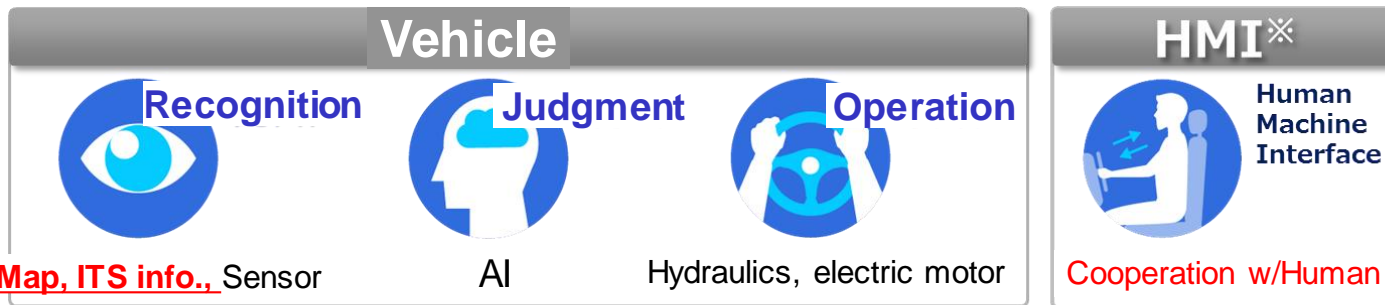
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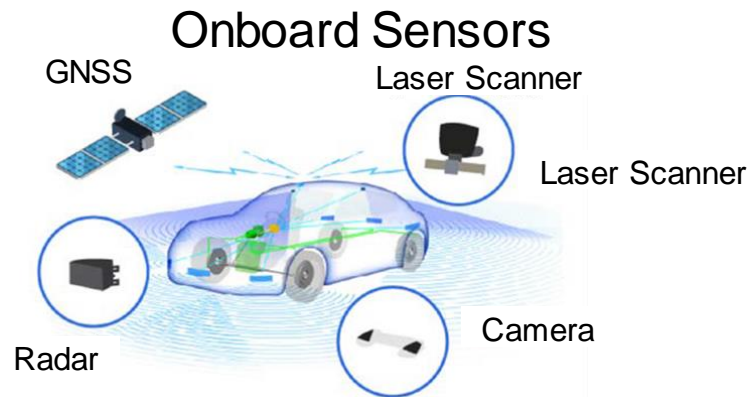
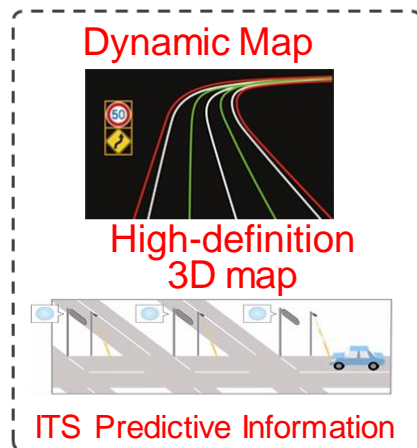
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- 1. SIP-adus' Activities**
- 2. Outline of the Large-Scale Field Operational Tests**
- 3. Dynamic Map**
- 4. Human machine interface (HMI)**
- 5. Cyber Security**
- 6. Pedestrian Traffic Accident Reduction**
- 7. Next Generation Transport**
- 8. Schedule**

SIP-adus focus on R&D in Cooperative area with Industry, Academia and Government



Enhanced
 • Self-position estimation
 • Neighboring environmental recognition
 are important for the automated driving system



Basic Tech.

Security, Simulation, Database, etc.

In red : Area of Cooperation
 ⇒ Main Area of SIP-adus

Toward deployment: Advancing development and deployment based on large-scale field operational tests for the "5 key themes"

2014

2015

2016

2017

2018

- ◆ Establishment of framework
- ◆ R&D on specific themes

Promoting Committee

System Implementation Working Group

International Cooperation Working Group

Next Generation Urban Transport Working Group

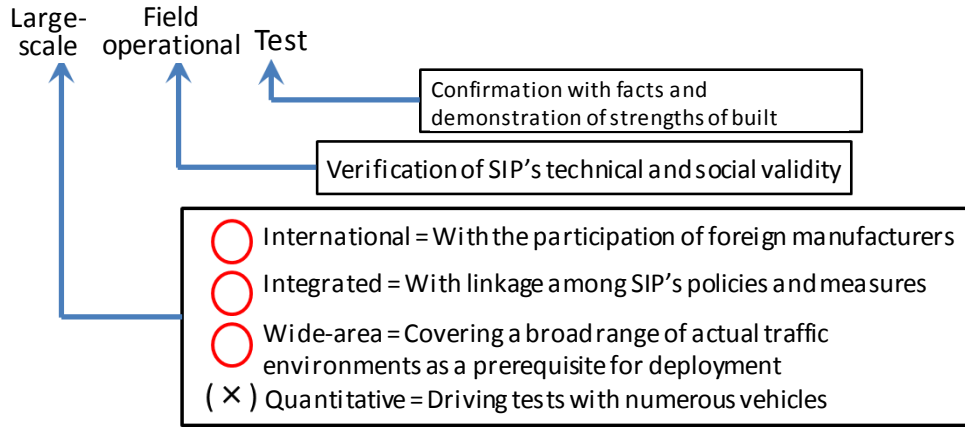
- ◆ Integration into five key themes

- ① **Dynamic Map**
- ② **Interaction between humans and Vehicles (HMI)**
- ③ **Cyber Security**
- ④ **Pedestrian traffic accident reduction**
- ⑤ **Next generation transport**

◆ **Large-scale field operational tests**

-  Activation of research/technical development
-  Evaluation/issue identification with more objectives
-  Focus on deployment
-  International cooperation and coordination
-  Nurturing of social acceptance

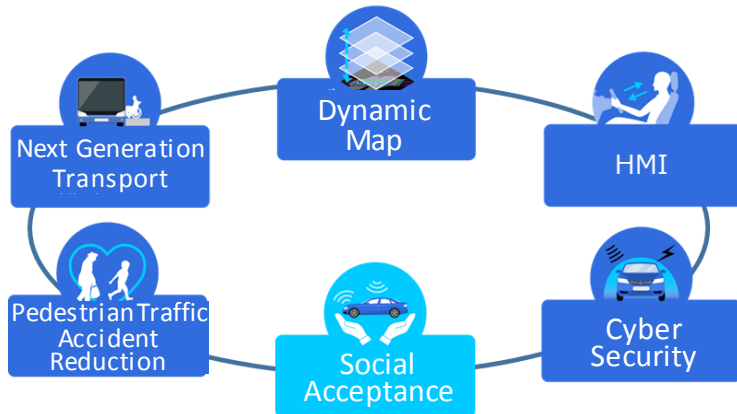
Practical application



Duration and test period

October 2017 to December 2018
(Test periods will be set individually depending on the content of the test.)

Themes



Participants

ALPINE Driving Mobile Media Innovation

Calsonic Kansei

Continental

mazda

名古屋大学 NAGOYA UNIVERSITY

SAITAMA INSTITUTE OF TECHNOLOGY

NISSAN MOTOR CORPORATION

SUZUKI

VOLKSWAGEN AKTIENGESELLSCHAFT

ZMP

BMW

MINI

BOSCH Invented for life

DAIHATSU

MLT MEIJI LogiTech

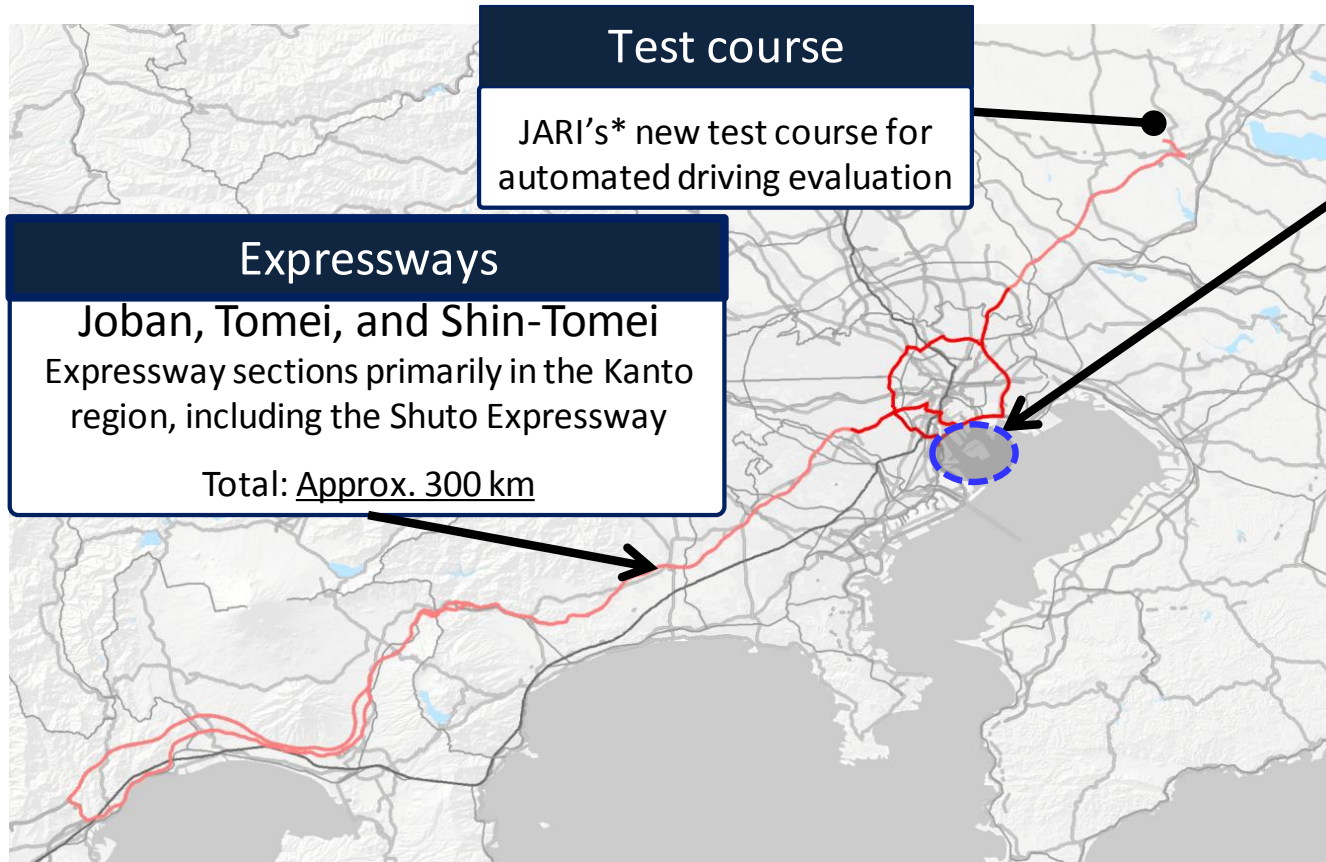
MITSUBISHI ELECTRIC

Pioneer

TOYOTA

SUBARU

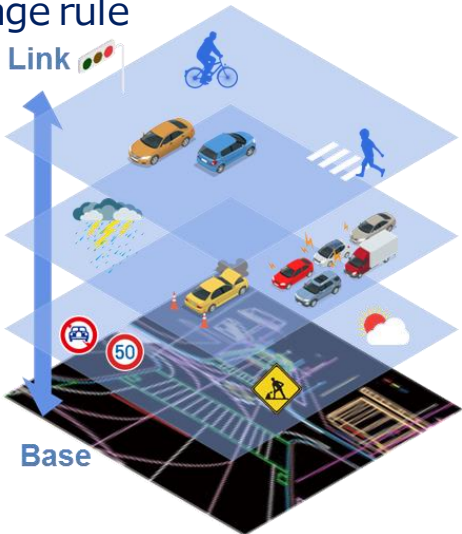
Presented in alphabetical order



(*JARI : Japan Automotive Research Institute)

Dynamic Map
(Supporting automated driving and safe driving)

Linkage rule



Dynamic Data

Movement of Vehicles, Status of Pedestrians, Traffic Signals etc.

Semi-Dynamic Data

Accidents, Congestion, Traffic Regulation, Road Construction, Detailed Weather, etc.

Semi-static Data

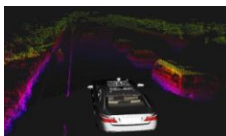
Traffic Regulation, Road Construction, Weather etc.

Static Data = High Definition 3D Map

Road, Lane, 3D Shape of Structures etc.

Use of **dynamic data** possessed by various entities

Platform



Digital Mapping

3D Common Platform Data

Point Clouds, Graphics, Probe Data etc.

Various Uses



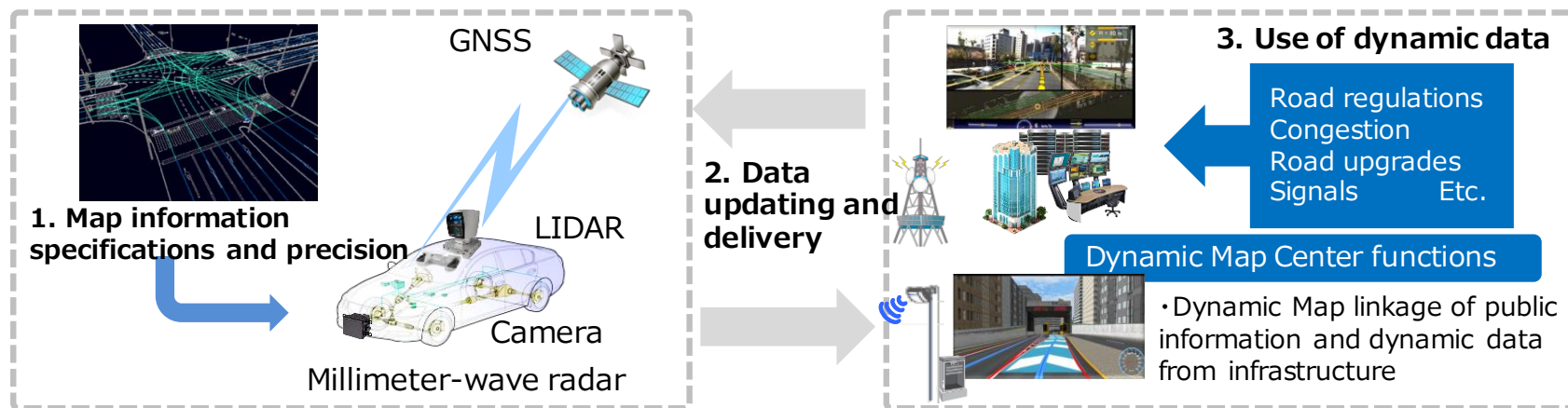
➤ Implementation of Dynamic Map field operational tests in three steps

Step 1: Verification of the specifications and precision of **High Definition 3D Map** (currently underway)

Step 2: Verification of map data **updating and delivery** systems (FY2018)

Step 3: Verification of **dynamic data linkage** for vehicle control and driver assistance (FY2018)

- ✓ The test environment for map data and dynamic data is prepared by SIP-adus.



Progress in the field operational tests of FY2017

- ◆ Participants are evaluating the high definition 3D map for 758 km inbound/outbound.
- ◆ Coverage of required features is being confirmed.

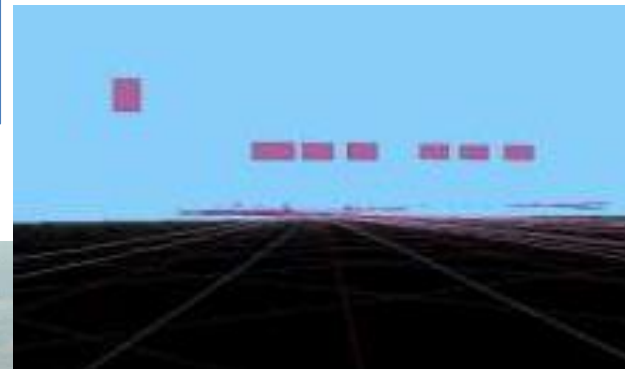
Aim to form a consensus for standardization

Example of identified issue



Participant's travel image

(1) Identification of data nonconformity



Distributed map data

(3) Confirmation of post-survey feature removal

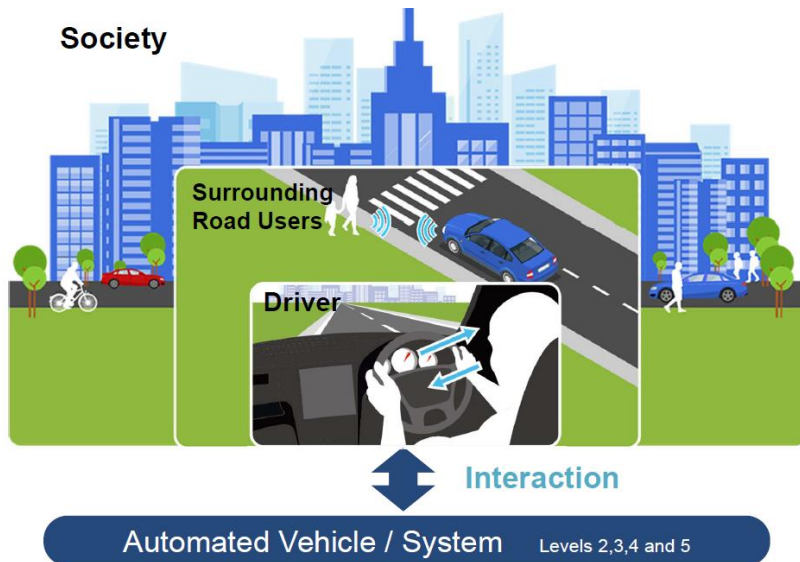


Survey image

(2) Confirmation of conformity with survey data

*Study of rules for data maintenance is a topic to be addressed going forward.

- Activities addressing three challenges concerning the HMI needed for automated vehicles (Level 3 and above)



Challenge A

Pre-knowledge and instruction method for automated driving system functions, readiness, and behavior that must be provided to the driver for appropriate driving

Challenge B

Detection of the driver's **readiness** (development of driver monitoring devices) and **clarification of the time required for take-over**

Challenge C

Identification of the **interface with other traffic participants** that automated vehicles should have



Field operational tests on test courses and actual traffic environments

Progress in the field operational tests of FY2017

- ◆ Development of **driver monitoring devices**
- ◆ **Data-gathering on public roads** by commercially available cars to **define** driving status **baseline indicators** has started.

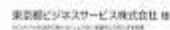
(At the end of January: 7,700 km driven by a total of 39 participants)



Next fiscal year

- ◇ Enhancement of **test data on the test course** using **Level 2 and Level 3 development vehicles**
- ◇ Guidelines formulation and standardization

HMI Consortium



Japan Automobile
Manufacturers
Association

Automated Driving Study
Group
HMI WG



Society of
Automotive
Engineers of Japan

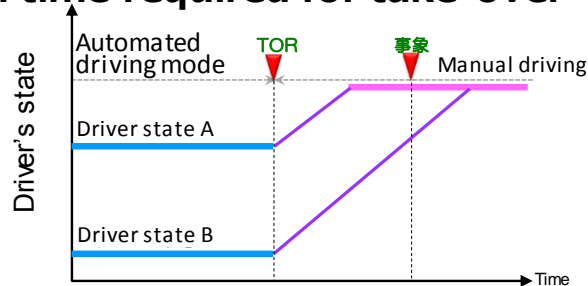
Ergonomics Task Force
HMI Subcommittee



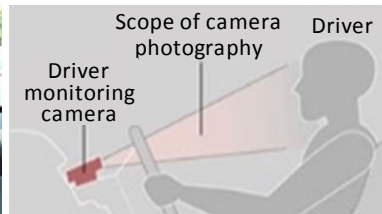
Large-Scale Field Operational Tests

Including domestic and overseas manufacturers

Research on detection of driver readiness and time required for take-over



TOR (Take-Over Request)



Development of driver monitor

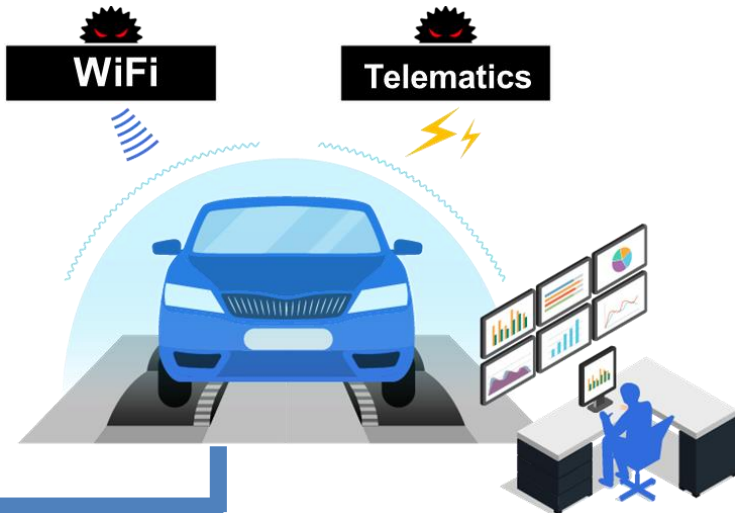
➤ Formulation of vehicle-level security evaluation guidelines

- ◆ Common Architecture Model
- ◆ Use Cases of Automated Driving
- ◆ Threat information
- ◆ Evaluation (attack) information



- ◆ Countermeasure
- ◆ Level of Countermeasure

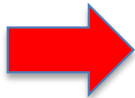
Vulnerability Evaluation trial



Threat analysis tools

Comparison with Current Threat Analysis

Cyber Security Evaluation Guideline



FY2018: Implementation of field trial test using actual vehicles based on the evaluation guidelines

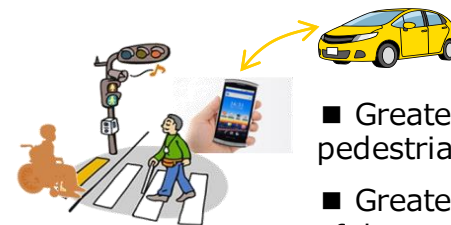
- Development of a vehicle-to-pedestrian mutual alert system using V2X communications technology

Vehicle-to-infrastructure communication using 79 GHz radar



- Use of high-resolution advantages
- Lower cost

Vehicle-to-pedestrian communication using pedestrians' terminal devices



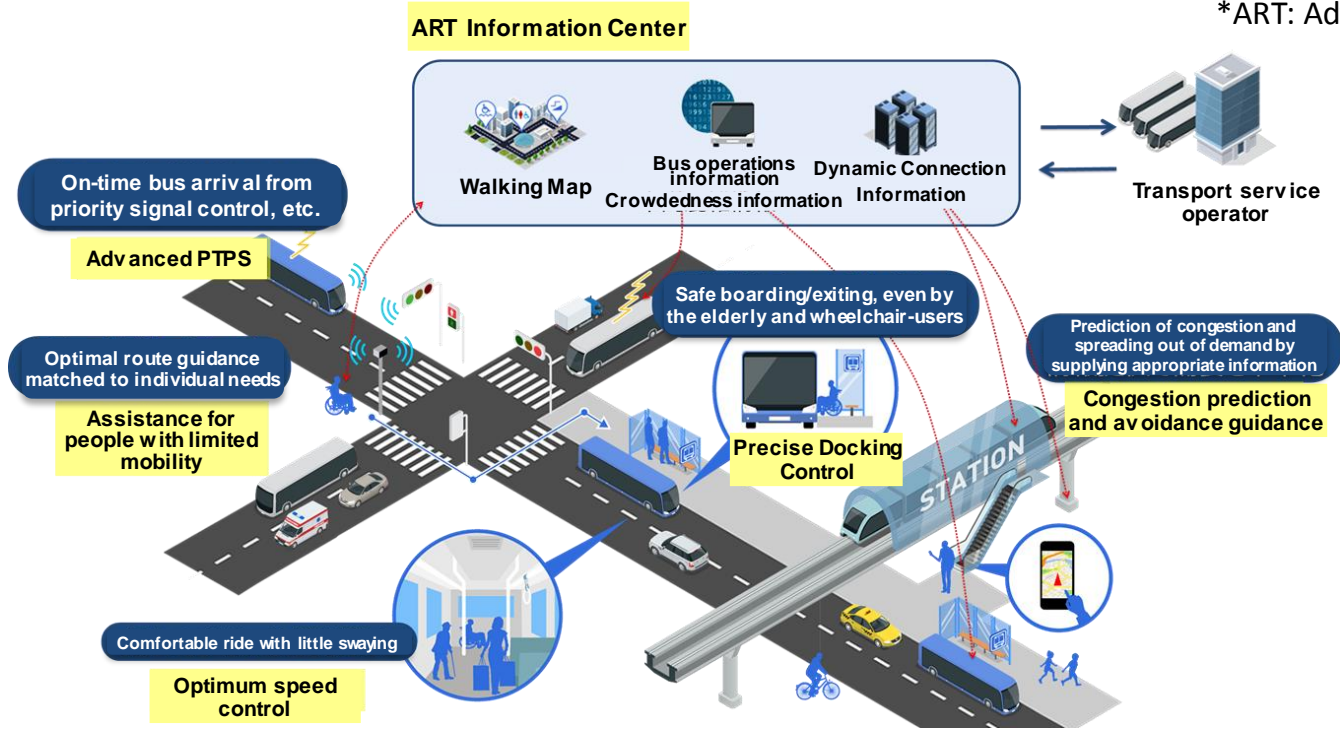
- Greater precision in pedestrian localization
- Greater sophistication of danger determination technology



➔ FY2018: Field operational test in the Tokyo waterfront area

➤ Development of technologies and services for realizing ART*

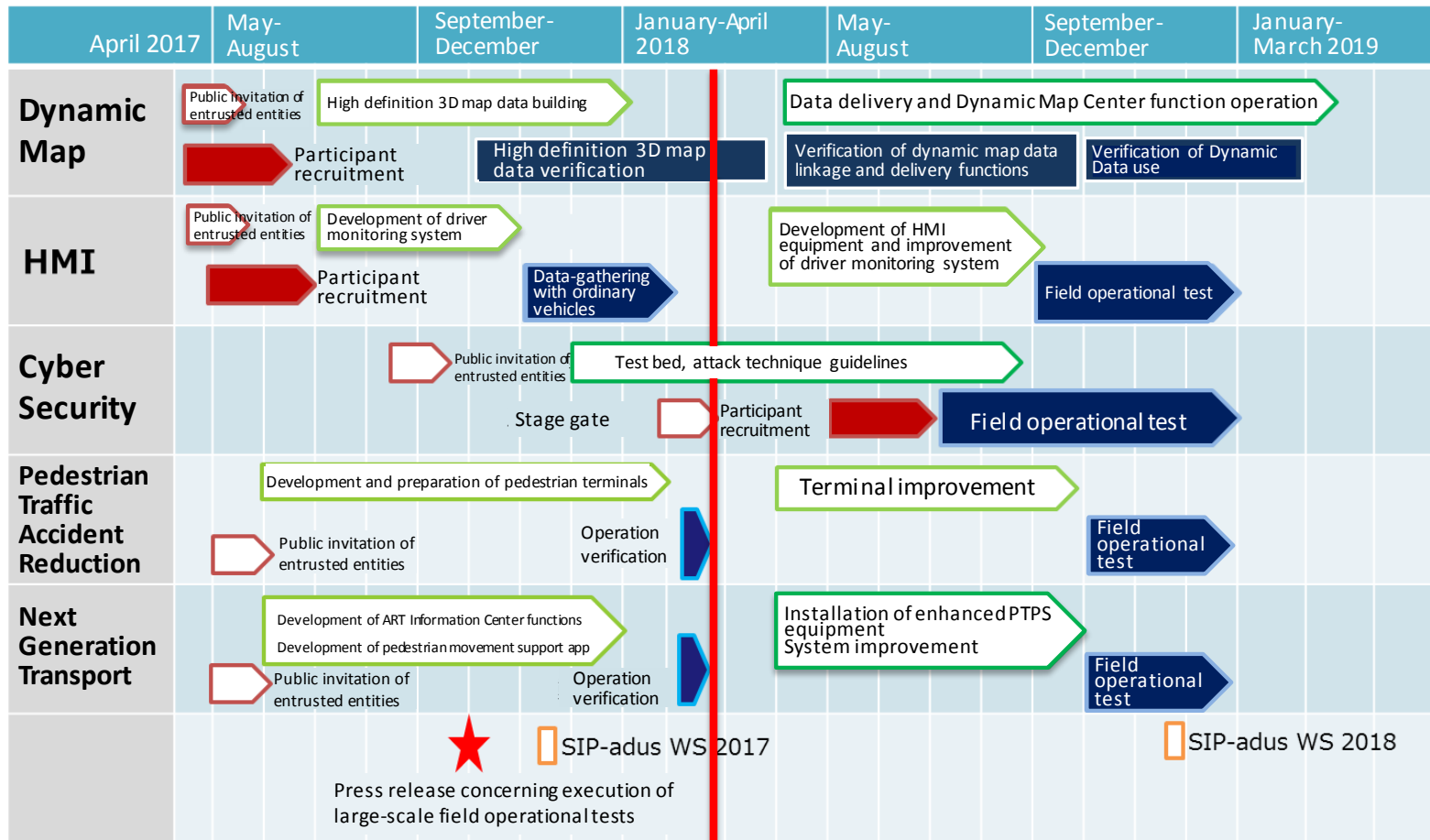
*ART: Advanced Rapid Transit



- ◆ Ascertainment of convenience, social acceptance, and commercial feasibility in actual traffic environments



FY2018: Field operational test in the Tokyo waterfront area





Thank you